EuropeWave Conference, Brussels

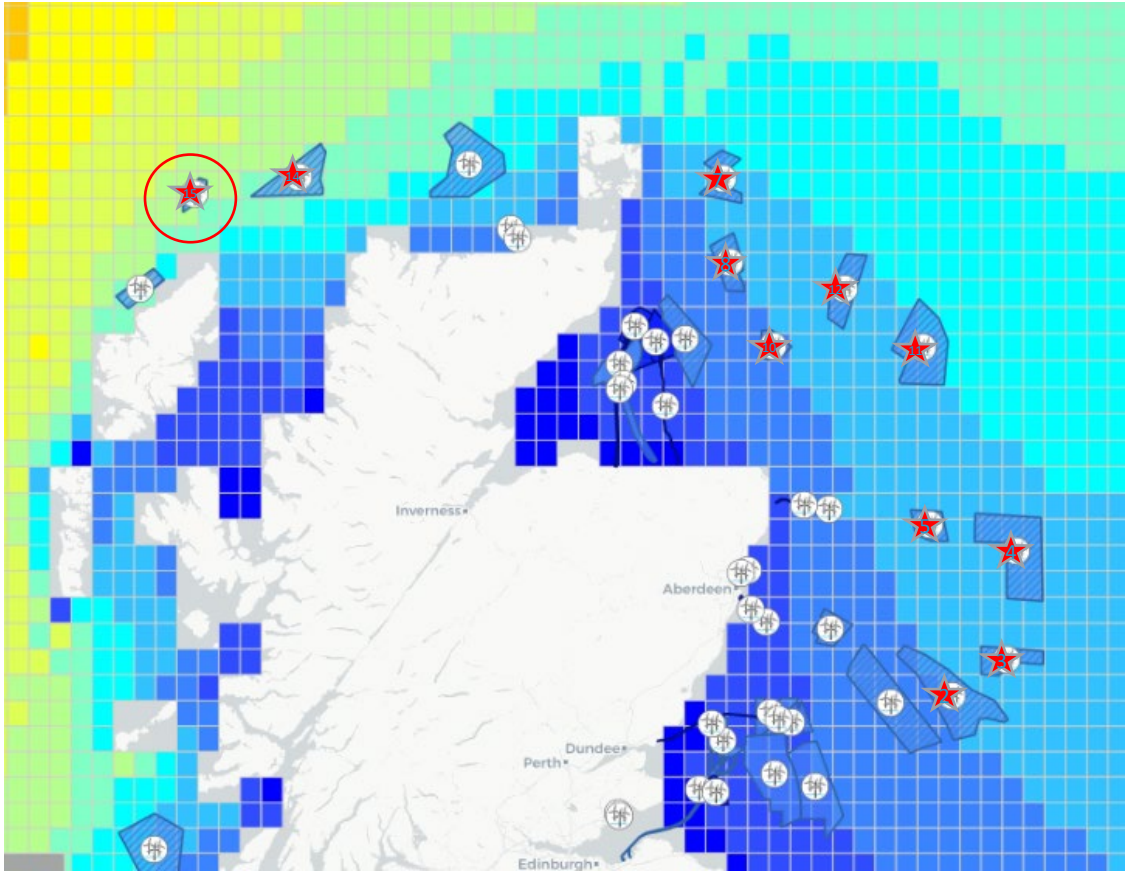
Floating wind and wave – shared and mutual benefits

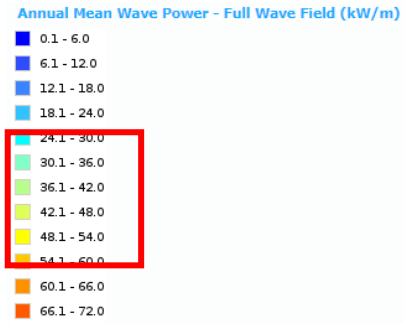
EUROPEWAVE

Tim Hurst, Wave Energy Scotland

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement 883751.

ScotWind Opportunities for Wave Energy



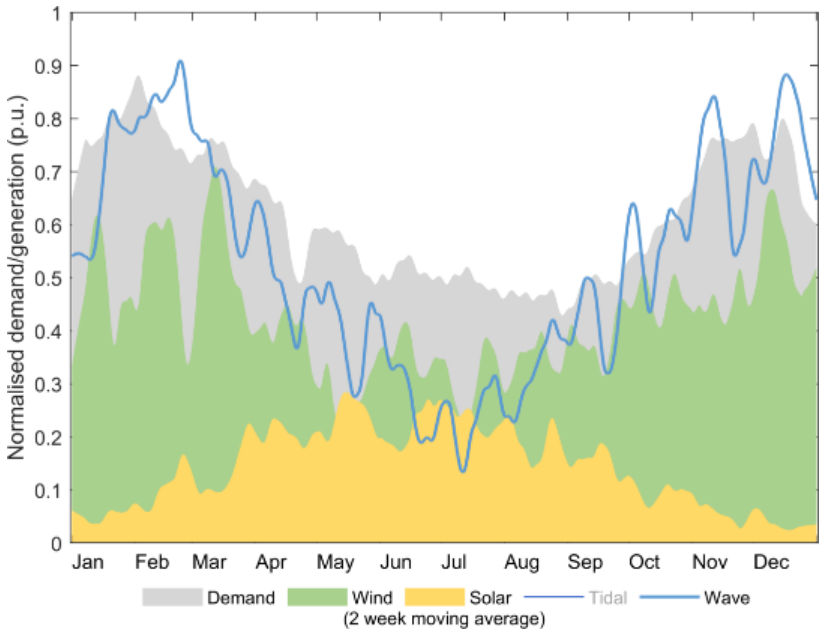


Map Reference	Lead applicant	Technology	Total capacity (MW)
1 (E1)	BP Alternative Energy Investments	Fixed	2,907
2 (E1)	SSE Renewables	Floating	2,610
3 (E1)	Falck Renewables	Floating	1,200
4 (E2)	Shell New Energies	Floating	2,000
5 (E2)	Vattenfall	Floating	798
6 (E3)	DEME	Fixed	1,008
7 (NE2)	DEME	Floating	1,008
8 (NE3)	Falck Renewables	Floating	1,000
9 (NE4)	Ocean Winds	Fixed	1,000
10 (NE6)	Falck Renewables	Floating	500
11 (NE7)	Scottish Power Renewables	Floating	3,000
12 (NE8)	BayWa	Floating	960
13 (N1)	Offshore Wind Power	Fixed	2,000
14 (N2)	Northland Power	Floating	1,500
15 (N3)	Magnora **	Mixed	495
16 (N4)	Northland Power	Fixed	840
17 (W1)	Scottish Power Renewables	Fixed	2,000
Totals			**24,826**

System Benefit

Supergen Offshore Renewable Energy
Policy and Innovation Group

How do demand and renewable energy resources compare?

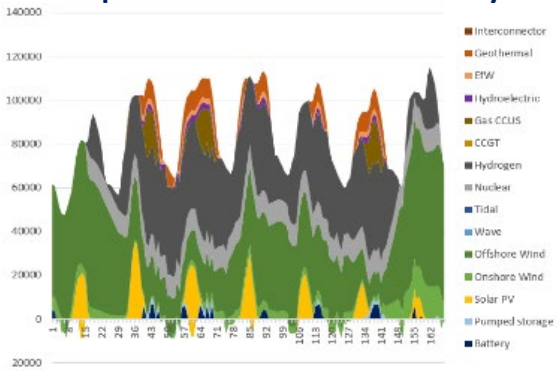


- Electricity demand is highly seasonal in GB
- Wind generation higher in winter
- Solar generation higher in summer
- Tidal consistently available - in cycles
- Wave generation higher in winter – coinciding with peak demand

System Benefit

How much wave and tidal could be installed by 2050?

Without marine
Dispatch for first week in January

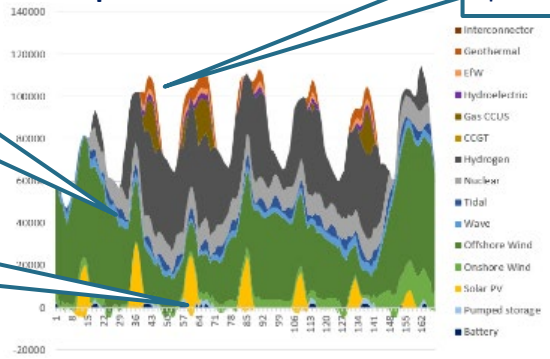


More renewable energy available at times of low wind resource

Lower requirements for battery storage

Lower requirements for peaking plant

With marine
Dispatch for first week in Ja

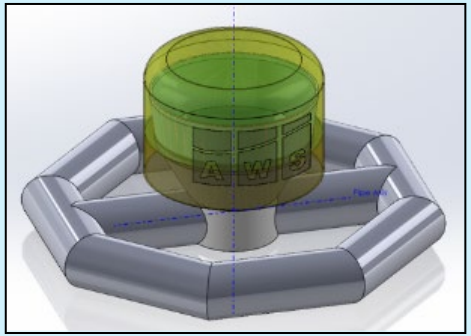


- 26.8 TWh higher renewables dispatch
- 4.7 TWh lower battery use
- 23.5 TWh lower peaking gen
- 300GWh lower fossil fuel use

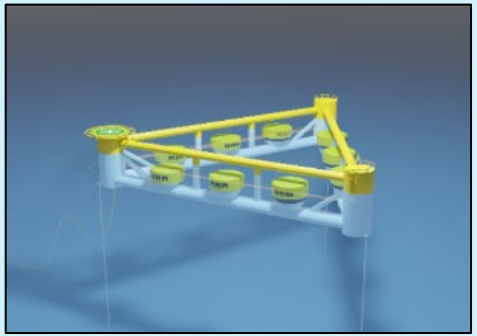
Annual dispatch cost: **£13.54B**

Annual dispatch cost: **£12.51B (-£1.03B/Annum)**

Wave Technology Scale Progression



500kW “Module”
to 9 x 500kW
4.5MW Platform



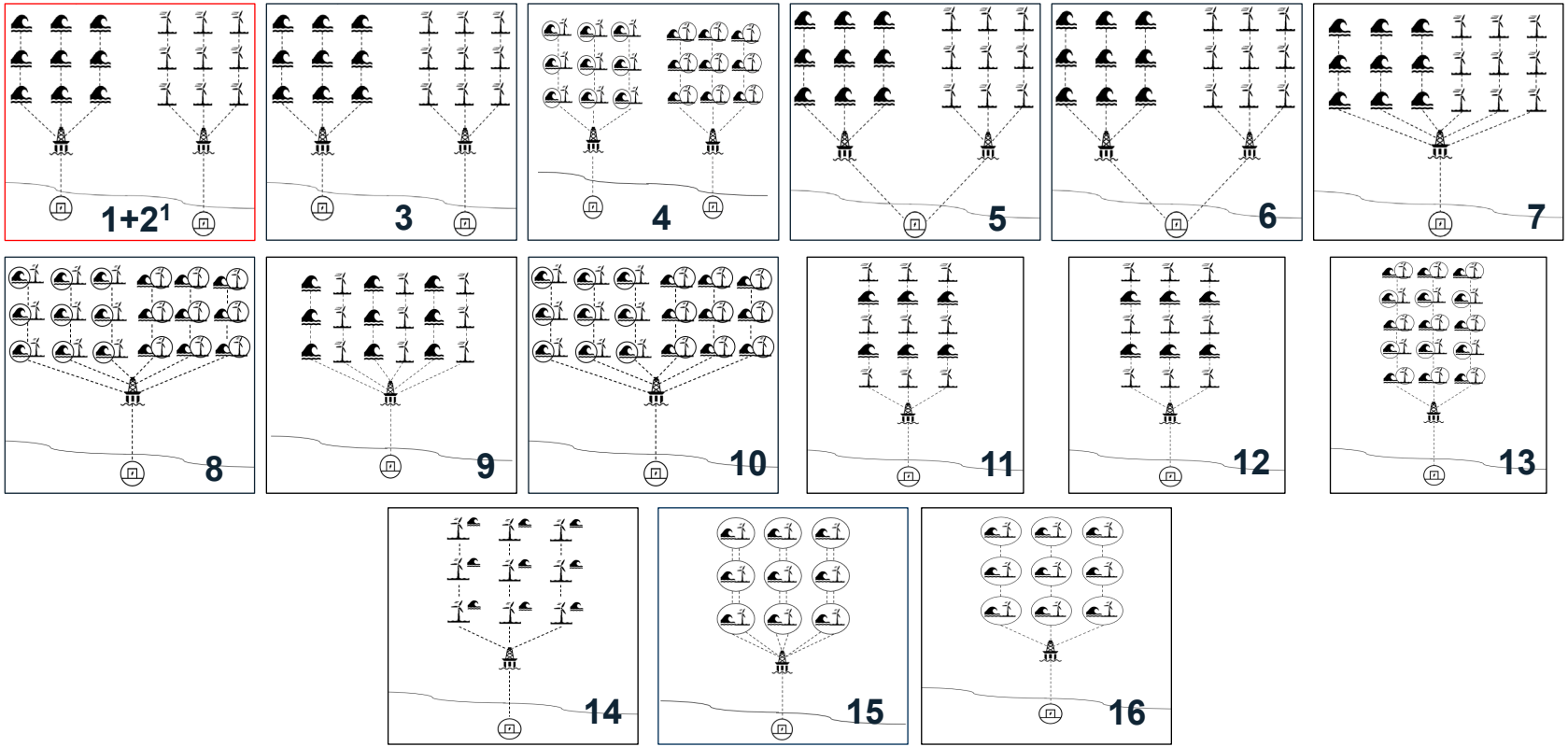
250kW to Multi MW
FOV Optimised Design

OWC
An ABL Group Company

Wave and Floating Wind Energy

owcltd.com

Overview of Shortlisted Scenarios



1 – This scenario corresponds to the baseline projects combined. Scenario 1 denotes the wind project independently and scenario 2 denotes the wave project independently. The two scenarios combined are also labelled as scenario 17

OWC
An ABL Group Company

Scenario Configurations

Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Spatial							Adjacent	Adjacent	Same site	Same site	Same site	Same site	Same site	Same site	Same site	Same site
Assets				VPs	OnSS	Landfall, onshore cables & OnSS	All tran. (except IACs)	All tran. (except IACs) & VPs	All tran. (except IACs)	All tran. (except IACs) & VPs	All tran.	All tran. & anchors	All tran., anchors & VPs	All tran. & PTO	All tran. (except IACs), HPs & anchors	All tran., HPs & anchors
Development			Surveys		OnSS consent	Onshore consent and surveys	Consent for all tran.	Consent for all tran.	Lease, surveys & consent	Lease, surveys & consent	Lease, surveys, consent & design	Lease, surveys, consent & design	Lease, surveys, consent & design	Fully shared	Fully shared	Fully shared
Supply chain			Small benefit to WEC	EoS due to use of VPs	OnSS	All onshore parts	All tran.	All tran. & VPs	All tran.	All tran.	Shared except WEC platform	Shared except WEC platform	Fully shared	Shared except WEC platform	Fully shared	Fully shared
Installation			Vessels & ports		OnSS	All onshore parts	All tran.	All tran.	All tran., vessels & ports	All tran., vessels & ports	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared
O&M			Vessels & ports		OnSS	All onshore parts	All tran.	All tran.	All tran., vessels & ports	All tran., vessels & ports	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared
Ownership			Independent but cooperative		Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	One project	One project	One project	One project	One project	One project

VP – Versatile platform. OnSS – Onshore substation. OSS – Offshore substation. Tran. – Transmission infrastructure. PTO – Power take-off. HP – Hybrid platform.
EoS – Economies of scale. Dev - developer

OWC
An ABL Group Company

Baseline Scenario Definition

- The first step in the scenario definition process is to define baseline scenarios for the wave and wind concepts in order to provide a point for comparison for the cost reduction potential assessment of the different sharing scenarios

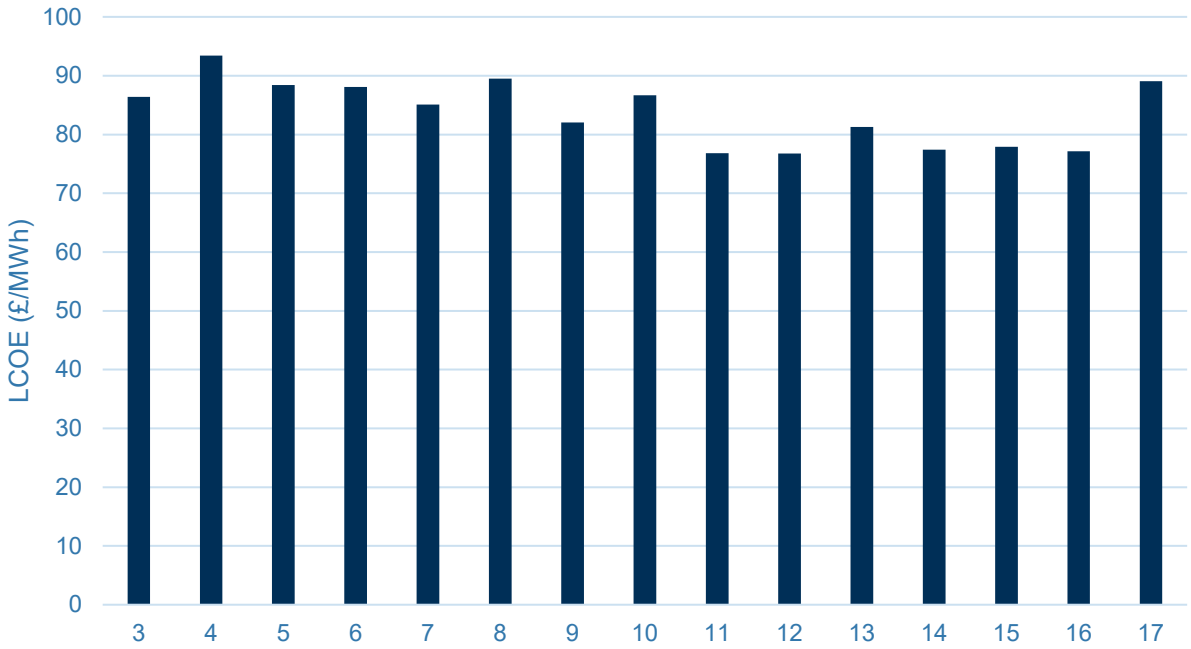
	Wave project	Floating wind project
Total capacity	100 MW	500 MW
Quantity	129 (0.778 MW each)	33 (15 MW each)
Technology	Point absorber	Steel semi-submersible
Mooring	Taut (polyester/chain)	Taut (polyester/chain)
Anchoring	VLA	Suction piles
Transmission	HVAC, 1x 132 kV	HVAC, 2x 220 kV
IACs	11 kV	66 kV
Distance to GCP	90 km (off), 10 km (on)	90 km (off), 10 km (on)
Development	6 years	8 years
Construction	1 year	2 years
Operation	25 years	25 years

Cost Reduction Analysis

© 2022 OWC

Findings – Combined LCoE

Combined LCOE



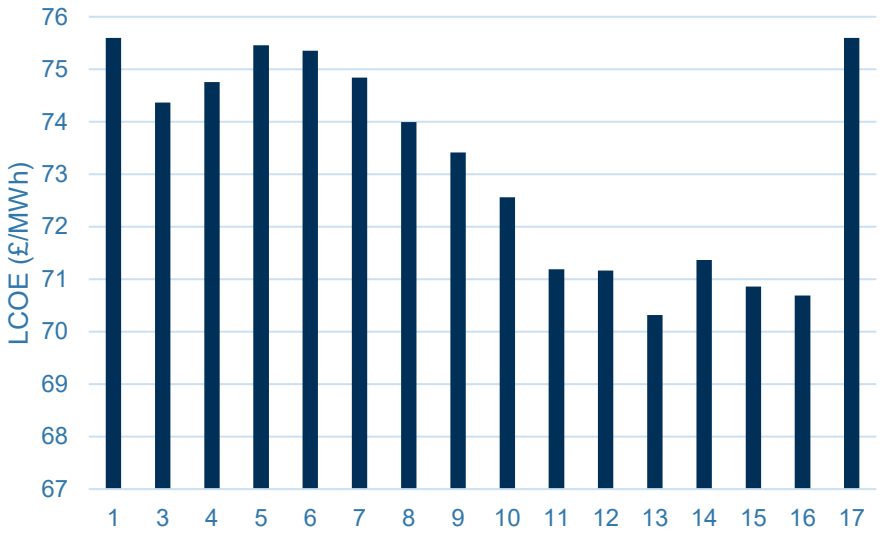
Key points

- Scenario 17 is the combined basecase (independent WTG and WEC projects)
- Max saving: 14% scenario 12 (all transmission, IACs, anchors shared)
- 11,12,14,15,16 have greatest benefits – all have transmission and non-asset based sharing, no additional overall benefit through IAC and platform sharing shown
- All scenarios result in overall cost reduction compared to basecase, except 4 and 8.
- Scenario 4 – versatile platform with independent projects
- 8, 10 and 13 are also versatile platform. WEC costs increased through platform use compared to basecase. Further investigation of platform design/size/weight and optimization would be worthwhile to validate this result.

OWC
An ABL Group Company

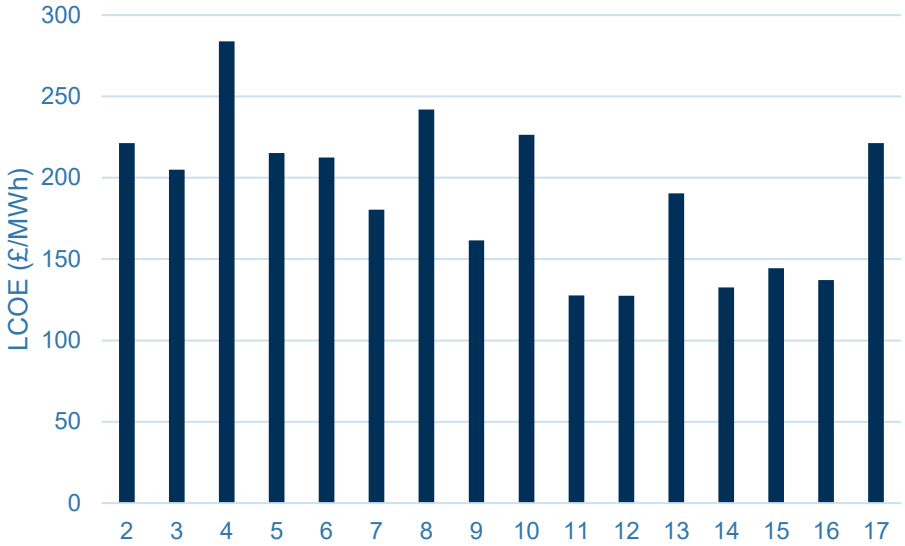
Findings – Split LCoE

WTG



Costs are reduced compared to base case in all scenarios from WTG perspective.
From WTG perspective, there is a more even trend of increasing benefit with increased level of sharing than for WECs. 13 is the versatile platform with shared IACs providing the greatest cost reduction.

WEC



4, 8, and 10 are versatile platform cases, and all result in a cost increase from the WEC perspective.
Optimal point is not achieved for greatest sharing.
7 is where offshore transmission becomes shared.

OWC
An ABL Group Company

Wider Benefits

© 2022 OWC

Available Benefits

Project Developers

- DEVEX, CAPEX and OPEX reductions, included in the LCOE section
- Load reduction depending on positioning of devices
- Possibility of reduced consenting risk due to reduced seabed usage where projects share space
- Increased utilisation of electrical and BoP assets
- Increased utilisation of vessels and equipment for surveys, installation, and maintenance activities

Technology Developers

- Opportunity to develop in emerging markets of floating wind and wave
- Opportunity to develop new IP through new technologies (e.g. versatile/hybrid platforms)

Regulatory and Political Authorities

- Reduced seabed usage and environmental impact by asset sharing
- Development of UK supply chains
- Increased local job creation
- Development of new markets in UK
- Improved progress towards UK renewable energy targets

Land Owners

- Reduced space requirements both offshore and onshore through sharing of assets (cable corridors, substations etc.)
- Potential for improved revenues where seabed lease is based on energy production
- Alignment with CES goals in terms of contributing to renewables growth and establishing a new market for wave energy/combined projects

Available Benefits

Community and Environmental Groups

- Increased local job creation
- Development of UK supply chains
- Reduced seabed usage and environmental impact by asset and logistics sharing
- Potential for community ownership

Industry and Suppliers

- Opportunity to develop in emerging markets of floating wind and wave
- Increased local job creation for ports and manufacturers
- Improved modularity of design (e.g. with versatile platforms), resulting in opportunities for economies of scale
- Supply chain consolidation and growth

Transmission Operators

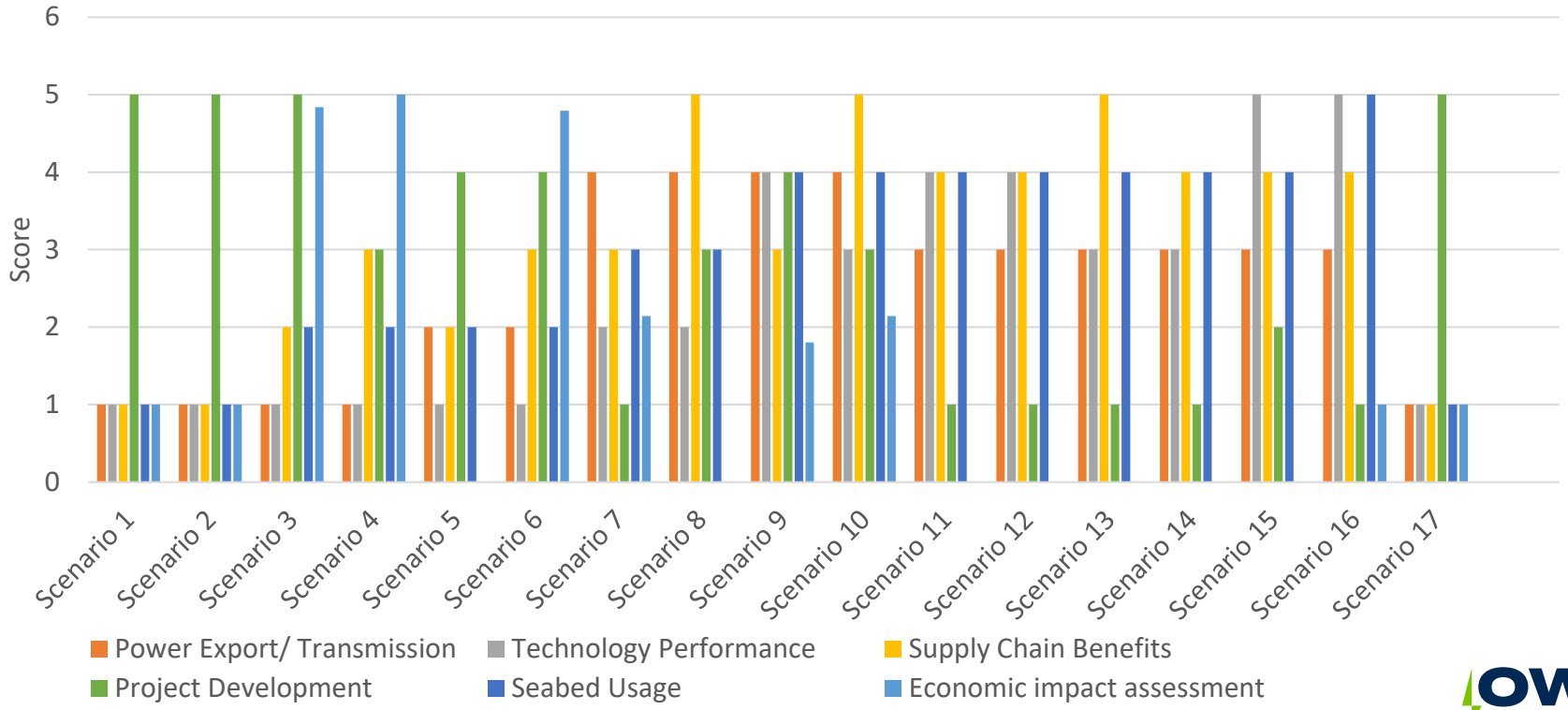
- Opportunities for power profile smoothing due to different temporal outputs of WECs and WTGs
- Reduced pressure on grid connection pipeline due to sharing of assets
- Increased utilisation of electrical and BoP assets
- Reduced transmission CAPEX

Scenario Rankings – Category Scores

		Power Export/ Transmission	Technology Performance	Supply Chain Benefits	Economic Impact Assessment	Project Development	Seabed Usage
Scenario ID	Criteria Weighting	20%	30%	20%	10%	10%	10%
Scenario 1	Base Case (WTG)	1	1	1	1	5	1
Scenario 2	Base Case (WEC)	1	1	1	1	5	1
Scenario 3	Indirect Synergies. No asset sharing	1	1	2	4.84	5	2
Scenario 4	Versatile Platform	1	1	4	5	3	2
Scenario 5	Shared Onshore Substation	2	1	2	N/A	4	2
Scenario 6	Shared Landfall & Onshore Substation	2	1	3	4.79	4	2
Scenario 7	Shared Offshore Trans. Hub	4	2	3	2.14	1	3
Scenario 8	Shared Trans. Hub & Versatile Platform	4	2	5	N/A	3	3
Scenario 9	Shared Offshore Trans. Hub & Vessels	4	4	3	1.8	4	4
Scenario 10	Shared Trans. Hub, Versatile Platform & Vessels	4	3	5	2.14	3	4
Scenario 11	Shared IAC	3	4	4	N/A	1	4
Scenario 12	Shared IAC & Anchor	3	4	4	N/A	1	4
Scenario 13	Versatile Platform, IAC & Anchor	3	3	5	N/A	1	4
Scenario 14	Shared PTO	3	3	4	N/A	1	4
Scenario 15	Combined Substructure, Separate IAC	3	5	4	N/A	2	4
Scenario 16	Fully Shared	3	5	4	1	1	5
Scenario 17	Base Case (WTG) Base Case (WEC)	1	1	1	1	5	1

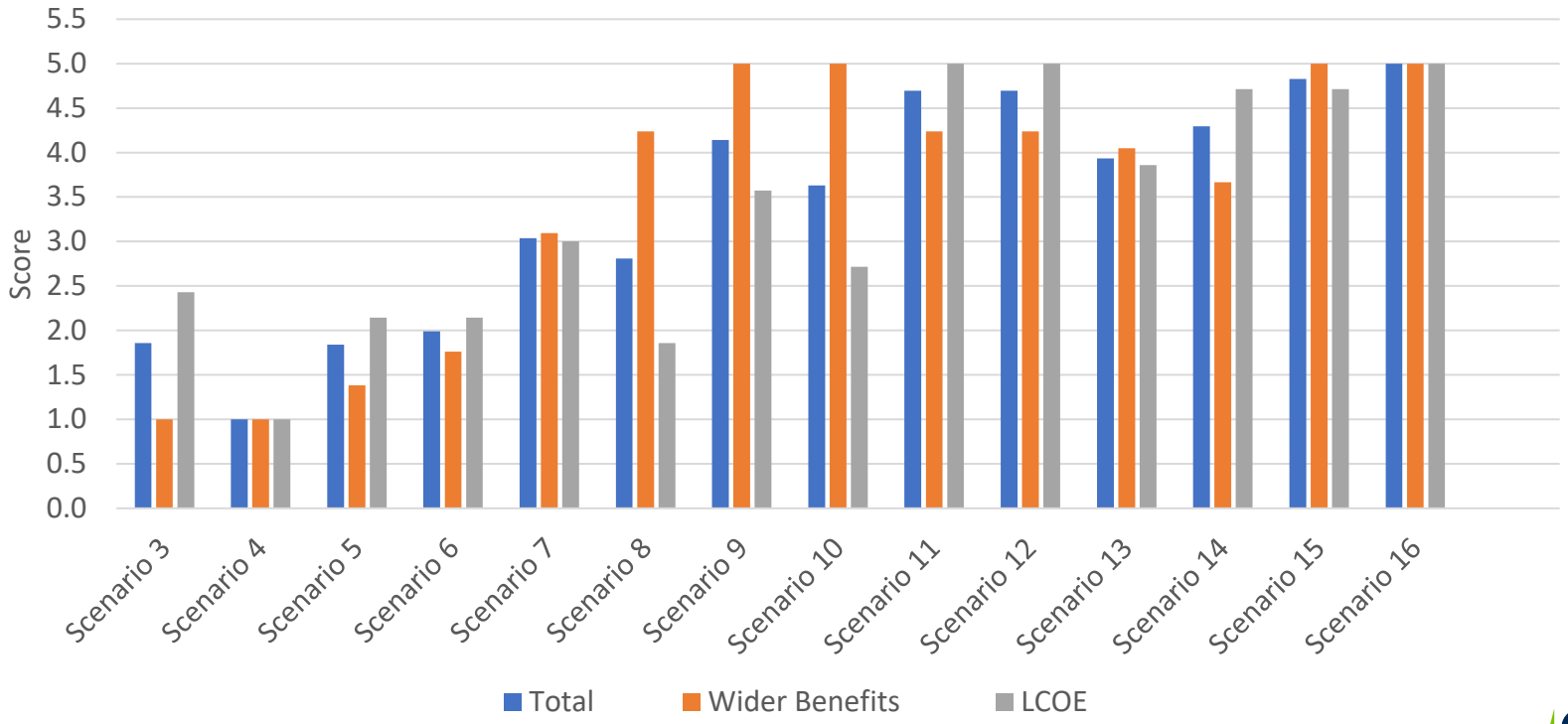
OWC
An ABL Group Company

Scenario Rankings – Category Scores



OWC
An ABL Group Company

Scenario Rankings - Overall

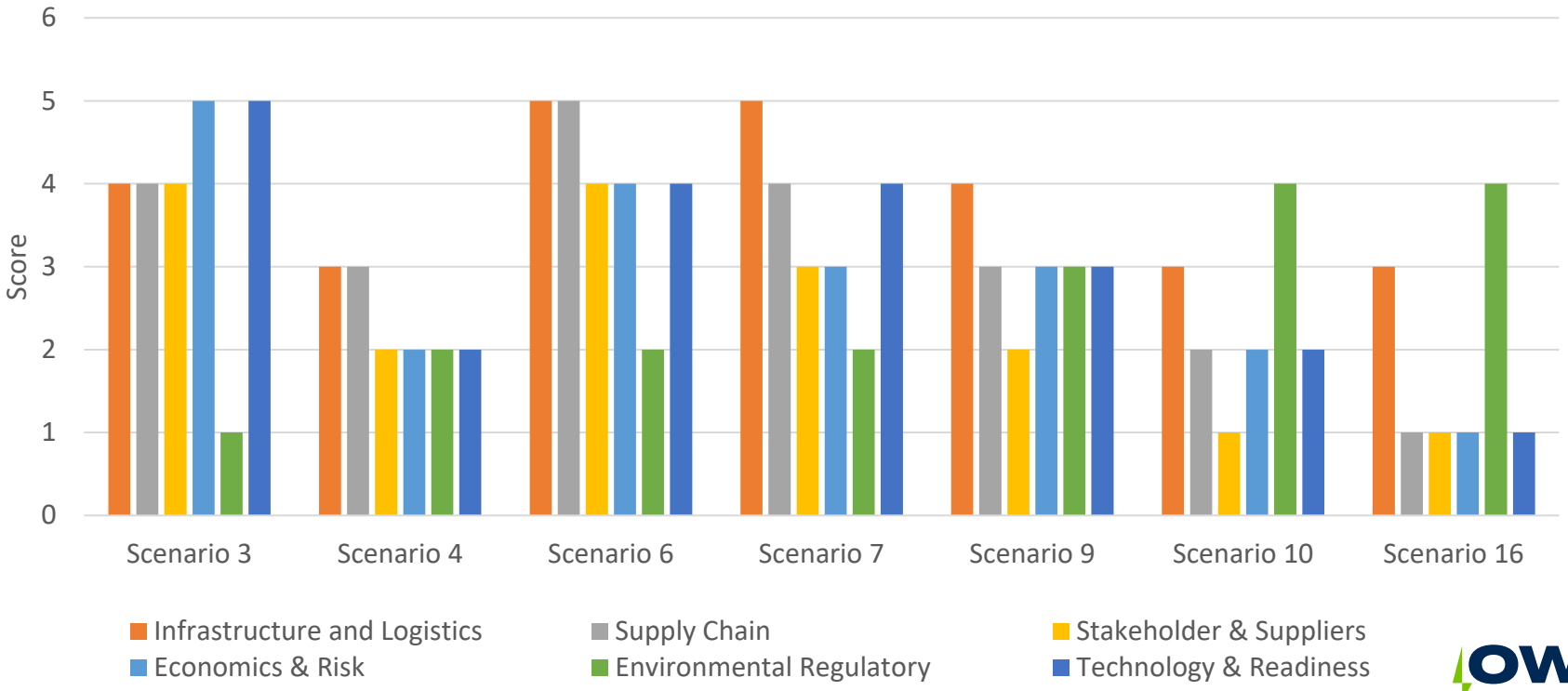


OWC
An ABL Group Company

Feasibility

© 2022 OWC

Scenario Rankings – Feasibility Risk Scores

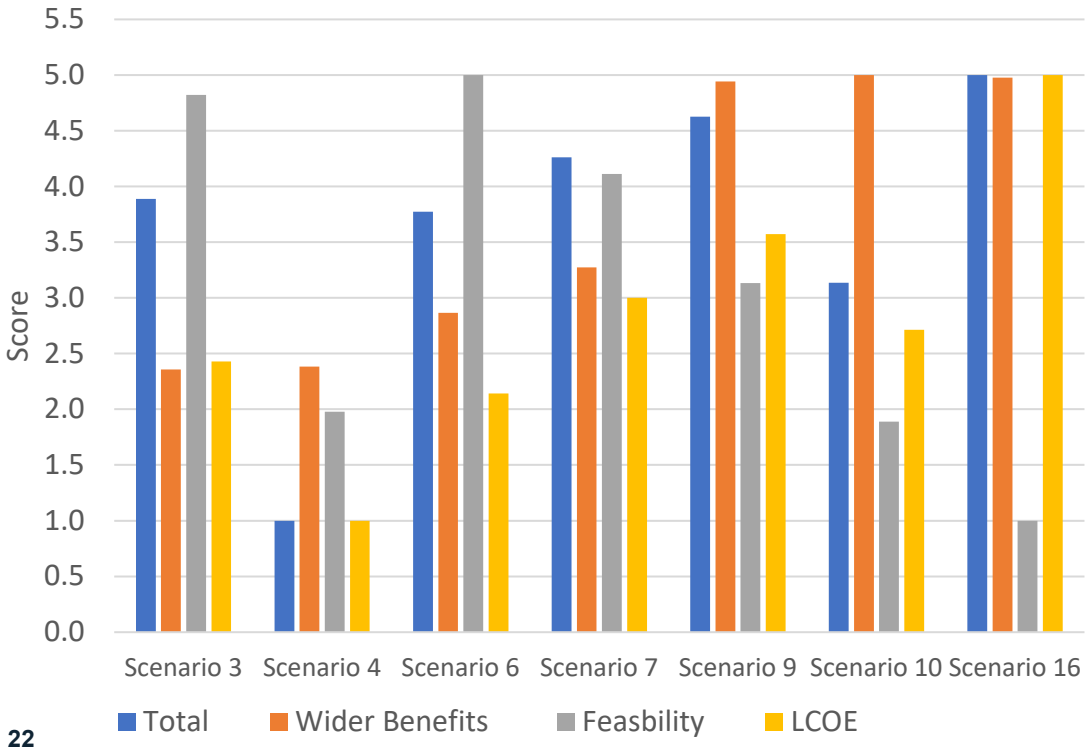


OWC
An ABL Group Company

Final Scenario Ranking

© 2022 OWC

Scenario Rankings – Final Combined Scores



Wider Benefits 5-Scale	LCOE 5-Scale	Feasibility 5-Scale	Total	Total 5-Scale	Total No-Weighting
10%	60%	30%	**100%**	-	
2.36	2.43	4.8	**3.1**	**3.89**	**9.61**
2.38	1.00	2.0	**1.4**	**1.00**	**5.36**
2.87	2.14	5.0	**3.1**	**3.77**	**10.01**
3.27	3.00	4.1	**3.4**	**4.26**	**10.38**
4.94	3.57	3.1	**3.6**	**4.63**	**11.65**
5.00	2.71	1.9	**2.7**	**3.14**	**9.60**
4.98	5.00	1.0	**3.8**	**5.00**	**10.98**

Note rankings are quite sensitive to the weightings applied – review weightings and decide

OWC
An ABL Group Company

Scenario Configurations

Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Spatial							Adjacent	Adjacent	Same site	Same site	Same site	Same site	Same site	Same site	Same site	Same site
Assets				VPs	OnSS	Landfall, onshore cables & OnSS	All tran. (except IACs)	All tran. (except IACs) & VPs	All tran. (except IACs)	All tran. (except IACs) & VPs	All tran.	All tran. & anchors	All tran., anchors & VPs	All tran. & PTO	All tran. (except IACs), HPs & anchors	All tran., HPs & anchors
Development			Surveys		OnSS consent	Onshore consent and surveys	Consent for all tran.	Consent for all tran.	Lease, surveys & consent	Lease, surveys & consent	Lease, surveys, consent & design	Lease, surveys, consent & design	Lease, surveys, consent & design	Fully shared	Fully shared	Fully shared
Supply chain			Small benefit to WEC	EoS due to use of VPs	OnSS	All onshore parts	All tran.	All tran. & VPs	All tran.	All tran.	Shared except WEC platform	Shared except WEC platform	Fully shared	Shared except WEC platform	Fully shared	Fully shared
Installation			Vessels & ports		OnSS	All onshore parts	All tran.	All tran.	All tran., vessels & ports	All tran., vessels & ports	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared
O&M			Vessels & ports		OnSS	All onshore parts	All tran.	All tran.	All tran., vessels & ports	All tran., vessels & ports	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared	Fully shared
Ownership			Independent but cooperative		Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	Wave dev pays wind dev	One project	One project	One project	One project	One project	One project

VP – Versatile platform. OnSS – Onshore substation. OSS – Offshore substation. Tran. – Transmission infrastructure. PTO – Power take-off. HP – Hybrid platform.
EoS – Economies of scale. Dev - developer

OWC
An ABL Group Company

Conclusions

© 2022 OWC

Conclusions

This study has investigated a range of sharing scenarios and compared these to base case independent wave and wind projects. The benefits as well as risks of each sharing scenario hsa been analysed with respect to cost/LCoE, qualitative wider benefits, economic impact and feasibility.

Key conclusions are as follows:

- There is potentail for significant cost reductions to be achieved:
  - Cost reductions of ~7% could be achieved for WTG developers by sharing aspects of their projects with WEC developers
  - Cost reductions close to 40% could be achieved for WEC developers
  - From a combined project perspective, the cost reduction could be around 14%.
- Scenarios which combined the most sharing options together achieved the greatest reduction, but sharing of IACs or platforms had little additional benefit beyond what could already be achieved
- Even without sharing assets the overall cost reduction could be around 3%, which is worth considering given the competitive nature of CFD rounds.

EUROPEWAVE

Thank you!

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement 883751.

www.europewave.eu @Europewave_EU info@europewave.eu